PCT WORLD INTELLECTUAL Interna

WO 9603261A1

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B26F 1/14 | A1

(11) International Publication Number: WO 96/03261

(43) International Publication Date: 8 February 1996 (08.02.96)

(21) International Application Number: PCT/US95/09329

(22) International Filing Date: 26 July 1995 (26.07.95)

(30) Priority Data:
P 44 26 498.4 27 July 1994 (27.07.94) DE
P 44 28 116.1 9 August 1994 (09.08.94) DE

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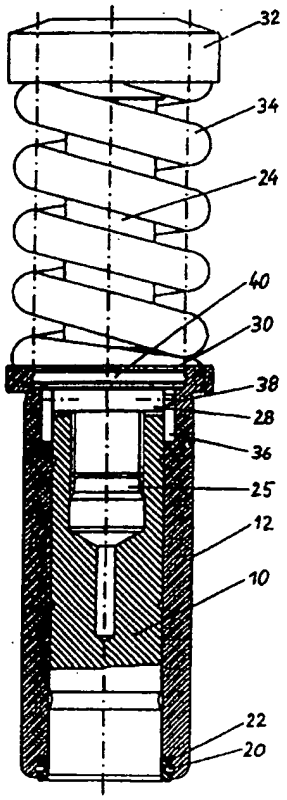
(81) Designated States: AT, AU, BR, CH, CN, CZ, DK, ES, FI, JP, KR, MX, NZ, SE, SG, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: PUNCH UNIT

(57) Abstract

A punch unit, comprising: a punch driver (24) with base (32); a spring bearing; a compression spring (34) between base (32) and spring bearing; a punch (10) threadedly and removably connected to punch driver (24); a guide bushing (12) with an open end to receive punch driver (24); safeguarding members (36, 38) positioned on punch driver (24) and guide bushing (12) to prevent relative rotation between punch (10) and punch driver (24) during a punch stroke. Safeguarding members comprise at least one radial protrusion (38) axially arranged on punch driver (24), and at least one axial groove (36) being open at an open end in guide bushing (12).



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PUNCH UNIT

Field of the Invention

The invention relates to a punch unit, comprising a punch driver connected with the back end of a punch by means of a threaded connection, safeguarding members, which keep the punch and the punch driver free of relative rotation during the stroke of the punch, and a compression spring which is pre-loaded between a base at the back end of the punch driver and a spring bearing disposed thereon and which during the stroke of the punch can be compressed between the base and a guide bushing, which receives the punch in a manner that it cannot be rotated, but is axially displaceable.

Background of the Invention

A punch unit of this type is known from U.S. Patent No. 5,131,303. In this structure the back end of the punch, which is provided with an exterior thread, is screwed into a threaded bore at the front end of the punch driver. The threaded section at the back end of the punch is provided with four axial, longitudinal grooves, and an open spring washer, whose one end is radially bent inward and projects through a radial hole into one of the axial grooves of the punch. The spring washer is seated on the exterior circumference of the front end of the punch driver. In the assembled state the guide bushing is frictionally connected via an O-ring with a washer seated on the punch driver underneath the compression spring and prevents the spring washer from being able to yield radially outward. In this way the punch and the punch driver are directly connected with each other by the spring washer without being able to rotate.

When the punch is to be reground, the punch driver can be pulled away from the guide bushing toward the rear, in the course of which the frictional connection at the O-ring is released. After the spring washer has left the guide bushing, the threaded connection between the punch and the punch driver can be released

by relative rotation. Because the radially inward bent end of the open spring washer has a point and the lateral walls of the grooves are inclined, the free end of the spring washer is pushed out of the groove in which it had been engaged when the punch is rotated in relation to the punch driver and, with continued relative rotation, then engages the next groove. Since the thread pitch is known, it is also known which change in the total length of the punch and punch driver corresponds to the rotational angle between two grooves. Because of this it is possible in a very simple way to reset the total length of the punch and punch driver following the regrinding of the punch. As soon as the guide bushing has subsequently again been pushed over the open spring washer and has been frictionally connected with the punch driver via the O-ring, the screw connection between the punch and the punch driver is again dependably blocked against relative rotation because the guide bushing does not permit the open spring washer to widen radially, so that therefore its radially inwardly bent end no longer can leave the radial groove with which it is in engagement at that time.

Although the known punch unit assures a simple setting of the total length of the punch and punch driver, it suffers from the essential disadvantage that the grooves intended for safeguarding against relative rotation weaken the thread through which the large punching forces are transmitted to the punch. This is of particular disadvantage in connection with punches having a relatively small cross section, as finer adjustment is required with decreasing cross section, because it is then necessary to have correspondingly more grooves at the circumference.

Summary of the Invention

It is therefore the object of the invention to provide a punch unit of the initially mentioned type wherein the weakening of the connection between the punch and the punch driver is avoided and an adjustment of its total length in arbitrary small steps is made possible.

The above object is attained in accordance with the invention in that the safeguarding members are formed by an engagement, interlocking in the circumferential direction, between the punch driver and the guide bushing in the axial area between the exterior back edge of the punch and the compression spring. The arrangement is preferably selected to be such that at least one radial protrusion is axially formed on the punch driver between the exterior back end of the punch and the compression spring which protrusion, in the assembled state, is in engagement with an axial groove, open at the back end, in the guide bushing.

The essential advantage is achieved by the invention in that axial grooves required for an adjustable safeguarding against relative rotation or other safeguard elements are disposed on or in a part which is unaffected by the punch forces, namely the guide bushing, whose weakening is of no consequence. Simultaneously the further advantage is achieved that, with the same punch cross section, the grooves are located on a larger radius. It is, therefore, easily possible to dispose more grooves at the circumference, and their angular accuracy is greater.

In view of the simplicity and the costs of the punch unit, a further advantage resides in that no or only very small changes in the punch itself, which is a wear item, need to be made for achieving the adjustable safeguard against relative rotation between the punch and the punch driver, which in accordance with the invention is now assured indirectly via the guide bushing. It is therefore not necessary to provide each replacement punch again with grooves, because this part of the safeguard against relative rotation is maintained together with the guide bushing when the punch is replaced.

In addition, the invention offers increased functional assurance. In connection with the initially mentioned known punch unit it could be possible that the fact that the spring washer constituting the safeguard against relative rotation was not in its correct locking position, could have remained unnoticed. In that case the stress of the punch force resulted

in the destruction of the tool. In contrast thereto, with the suggested punch unit it can be very clearly noticed whether the radial protrusion on the punch driver has entered one of the grooves in the guide bushing or whether the parts still are in their separated position required for a relative rotation.

In a preferred embodiment of the invention the radial protrusion is arranged on a set collar which can be screwed onto a threaded section of the punch driver, can be fixed in place in a defined position and represents the spring bearing. This is necessary anyway and is also not a wear item. In this embodiment the punch itself does not require any additional processing.

The invention will be explained in detail below by means of an exemplary embodiment illustrated in the drawings.

Brief Description of the Drawings

There follows a detailed description of the preferred embodiments of the present invention which are to be taken together with the accompanying drawings, wherein:

Figs. 1 and 2 are lateral views, partially in section, of a punch unit in the completely assembled state, wherein the sectional planes through the punch in Figs. 1 and 2 are offset by 45° in respect to each other and in relation to the center axis; and

Figs. 3 and 4 are views corresponding to Fig. 1 or Fig. 2 in a position of the parts wherein they are sufficiently pulled apart axially so that a respective relative rotation of the upper part in respect to the lower part is possible.

Detailed Description of the Preferred Embodiments

Referring now to the figures, like elements are represented by like numerals throughout the several views.

The punch unit represented in Figs. 1 to 4 consists in a known manner of a punch 10 guided linearly displaceable in a guide bushing 12. A rotation of the punch 10 in relation to the guide bushing 12 is prevented by a pin 16, fixedly seated in a

radial bore 14 in the punch 10, which protrudes radially and engages an interior longitudinal groove 18 in the guide bushing 12. This axial groove 18 is also radially outwardly open over a portion of its length, so that a pin, not shown, or other securing member can engage the groove 18 from the outside and can maintain the guide groove 18 or bushing 12 non-rotatingly on the machine frame, not shown. In this respect, as well as in relation to the disposition of a stripper ring 22 fastened on the lower end of the guide bushing 12 by a securing or fixing washer 20, the disclosed punch unit corresponds to conventional designs.

In further agreement with known punching tools, the back or upper end of the punch 10 is screwed together with a punch driver 24. In the exemplary embodiment represented, the back end of the punch 10 is provided with a threaded bore 25 for this purpose, into which the front end 26, which is provided with an exterior thread, of the punch driver 24 is screwed. The total length of the punch 10 and the punch driver 24 is set by screwing the front end of the punch driver 24 into the threaded bore 25 of the punch 10 more or less deeply.

A set collar 28, provided with a corresponding interior thread, is located above the punch 10 on the exterior thread of the front end 26 of the punch driver 24. Its cross section is of a slightly smaller size than the punch 10, because during the stroke of the punch it performs an axial relative movement in the guide bushing 12 together with the punch 10. An intermediate ring 30 is supported on the set collar 28 and is seated, freely displaceable, on the shaft of the punch driver 24 which adjoins the front end 26 provided with the thread above or toward the rear. The set collar 28 forms a stop for the movement of the intermediate ring 30 in the axially forward or downward direction of movement.

Between a base 32 disposed at the upper or back end of the punch driver 24 and the intermediate ring 30, a compression spring 34 is clamped in a known manner, whose pre-load can be set or adjusted in that the set collar 28 is screwed to a greater or lesser extent on the exterior thread on the front end 26 of the punch driver 24 and is then fixed in place. The position secure

against relative rotation of the set collar 28 can be achieved, for example, by a securing screw (not shown) screwed into a radial threaded bore and engaging the exterior thread on the front end 26 of the punch driver 24.

The punch driver 24, together with the set collar 28 screwed on its front end 26 and the spring 34 maintained under pre-load by this and with the intermediate ring 30, forms a preassembled unit which is connected with the punch 10 seated in the guide bushing 12 in that the front end 26, provided with the thread, of the punch driver 24 is screwed into the corresponding threaded bore in the back end of the punch 10. This screw connection makes it possible to remove the punch 10 from the punch driver 24 for the purpose of regrinding. The smaller punch work piece makes the regrinding process easier. In addition, the threaded connection at the front end 26 of the punch driver 24 allows an increased length compensation of the shortening connected with the regrinding of the punch 10.

In order to maintain a constant defined, set total length of the punch 10 and the punch driver 24, it is necessary to prevent the relative rotation of these two parts during punching. At the same time a very simple adjustment possibility of the length is demanded, and finally the locking, secure against relative rotation, should not weaken the greatly stressed parts and should have the lowest possible manufacturing and assembly costs.

One or a plurality of longitudinal grooves 36, which are distributed over the circumference and are open toward the top or the back, in the back end of the guide bushing 12 and one or a plurality of radial protrusions 38 on the punch driver 24, which are to be brought into engagement with these grooves, are sufficient in the punch unit shown to achieve all these goals. The axial grooves 36, for example two, four or six grooves cut evenly distributed over the circumference into the guide bushing in addition to the slightly wider longitudinal groove 18 and whose length does not need to be much greater than the maximum stroke of the punch, are located on a comparatively large radius and only weaken the guide bushing 12, which is not stressed by

the punch force. Even with small punch cross sections it is possible to easily cut four, six or even more grooves 36 in the interior circumference of the guide bushing 12. Only the manufacturing costs of a comparatively long-lived part of the tool are increased by the work required for the grooves 36, so that this cost is hardly of any consequence.

The radial protrusion 38 on the side of the punch driver 24 is preferably disposed on the set collar 28. The protrusion can be formed, for example, by a set screw screwed into a radial threaded bore in the set collar 28 - for example, even by the screw by means of which the set collar 28 is maintained fixed against relative rotation on the punch driver 24 - or by a pin pressed into a radial bore which, the same as the set screw mentioned, protrudes radially in respect to the set collar 28 and can be brought into engagement with one of the longitudinal grooves 36.

The punch unit shown has the particular advantage that changes of the total length of the punch 10 and the punch driver 24 can be made very rapidly and simply. Starting with the position represented in Figs. 1 and 2, it is only necessary to lift the punch driver 24 together with the parts connected with it sufficiently far in relation to the guide bushing 12 maintained on the machine frame, so that the radial protrusion 38 has left the groove 36, open at the top, which receives it, in a direction toward the back or upward. This retracted position of the punch driver 24 is represented in Figs. 3 and 4. Now if in this position, or in a position in which it is even further lifted or retracted, the punch driver 24 is turned in one or the other direction, while the punch 10, together with the guide bushing 12, is maintained fixed against relative rotation by the engagement of the pin 16 with the groove 18, the engagement length by which the front end 26, provided with the exterior thread, of the punch driver 24 engages the threaded bore 25 in the back end of the punch 10 is changed. Since the pitch of this thread is known, the value by which the total length of the punch 10 and the punch driver 24 is changed, is also known if, together with the latter, the radial protrusion 38 is rotated

by the pitch angle between two grooves 36. It is understood that with an increase in the number of grooves 36 distributed over the circumference the adjustment accuracy is increased. In the course of this, for example, there is also the option to embody the grooves 36 in the form of an interior toothing and the exterior circumference of the set collar 28 in the form of an exterior toothing which is to be brought into engagement with this interior toothing.

To ease the setting of the total length of the punch 10 and the punch driver 24, it is possible to apply visible markers on the existing grooves 36 on the exterior circumference of the guide bushing 12.

After having set the desired total length, it is only necessary to lower the punch driver 24 back into the position shown in Figs. 1 and 2, in which the radial protrusion 38 is again in engagement with one of the grooves 36. In the embodiment shown, in this position the intermediate ring 30, whose exterior diameter is greater than the set collar 28, is seated in a widened bore section at the rearmost end of the guide bushing 12. The intermediate ring 30 has an O-ring 40 in an annular groove on its exterior circumference which, in the position shown in Figs. 1 and 2, is seated radially compressed in the widened bore section at the rearmost end of the guide bushing 12. A seal against the emergence toward the back of lubricant from the guide bushing 12 is provided in this way. In addition, the O-ring 40 constitutes an easily releasable frictionally engaged connection between the guide bushing 12 and the punch driver 24. It can additionally be secured in that the widened bore section in the rearmost end of the guide bushing 12 is embodied with an interior annular groove which is engaged by the O-ring 40.

As can be seen from Figs. 1 and 2, during the stroke of the punch the pressure force required for punching is transmitted via the continuous threads on the front end 26 of the punch driver 24 and in the axial threaded bore 25 in the back end of the punch 10. While being compressed during the stroke of the punch, the comparatively large compression spring 34 is no longer

supported via the intermediate ring 30 on the set collar 28, which is only used for setting the pre-load, but in a known manner on the back end of the guide bushing 12.

In the embodiment described above, the radial protrusion 38 is disposed on the set collar 28 which, in turn, is seated on the punch driver 24 between the back end of the punch 10 and the spring 34. It is understood that it is possible to directly or indirectly dispose a radial protrusion 38, which is to be brought into engagement with one or a plurality of grooves 36 in the back end of the guide bushing 12, on the punch driver 24 even if, differently from the way shown in the drawings, the front end of the latter is provided with a threaded bore into which the back end of the punch 10, which is provided with an exterior thread, can be screwed. Also, the arrangement of the radial protrusion and the grooves can be reversed in that a radially inward extending protrusion is embodied or disposed at the back end of the guide bushing 12 which engages one of several axial grooves at the exterior circumference of the set collar 28. In this case the radial protrusion should suitably be disposed on a radius which is greater than the radius of the punch 10.

Although the invention has been described in considerable detail with respect to preferred embodiments thereof, variations and modifications will be apparent to those skilled in the art without departing from the spirit and scope of the invention as set forth in the claims.

Claims

What is claimed is:

1. A punch unit, comprising:

a punch driver having first and second ends, said second end having a base thereon, said punch driver including a spring bearing mounted between said first and second ends, a compression spring clamped under pre-load between said base and said spring bearing and a punch having a back end removably connected to said first end of said punch driver by means of a threaded connection;

a guide bushing having an open end into which at least said first end of said punch driver is insertable for guiding axial displacement of said punch during a stroke of said punch; and

corresponding safeguarding members positioned on said punch driver and on said guide bushing which engage in a circumferential direction between said punch driver and said guide bushing for preventing relative rotation between said punch and said punch driver during a stroke of said punch.

2. The punch unit according to claim 1 wherein said safeguarding members comprise at least one radial protrusion axially arranged on said punch driver between said back end of said punch and said compression spring and at least one axial groove in said guide bushing, said axial groove being open at said open end of said guide bushing.

3. The punch unit according to claim 2 wherein said spring bearing comprises a set collar which is attachable by a threaded connection to said punch driver.

4. The punch unit according to claim 3, wherein said radial protrusion is mounted on said set collar.

5. The punch unit according to claim 3 wherein said radial protrusion comprises a pin inserted into a radial hole in said set collar.

6. The punch unit according to claim 3 further comprising an intermediate ring seated on said punch driver between said set collar and said compression spring, said intermediate ring being axially supported on said set collar and on said guide bushing and having, on an exterior circumferential face, a radially protruding O-ring which rests against an interior wall of said

guide bushing when said radial protrusion is in said axial groove, said O-ring being frictionally engageable and axially releasable with said interior wall.

7. The punch unit according to claim 2 wherein said guide bushing includes more than one axial groove and said radial protrusion or protrusions on said punch driver are fewer in number than said axial grooves.

8. The punch unit according to claim 2 wherein said axial grooves are slightly longer than the length of linear movement between said punch and said guide bushing during a stroke of said punch.

9. The punch unit according to claim 2 wherein said punch driver includes a shoulder, said punch driver and shoulder comprising a single-piece construction, said radial protrusion being mounted on said shoulder.

Fig. 1

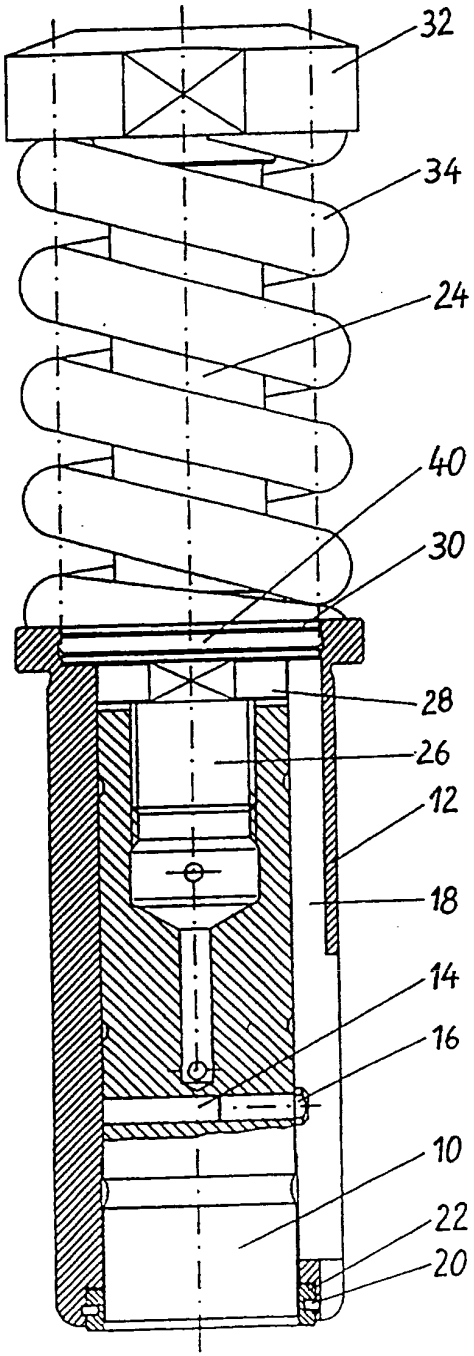


Fig. 2

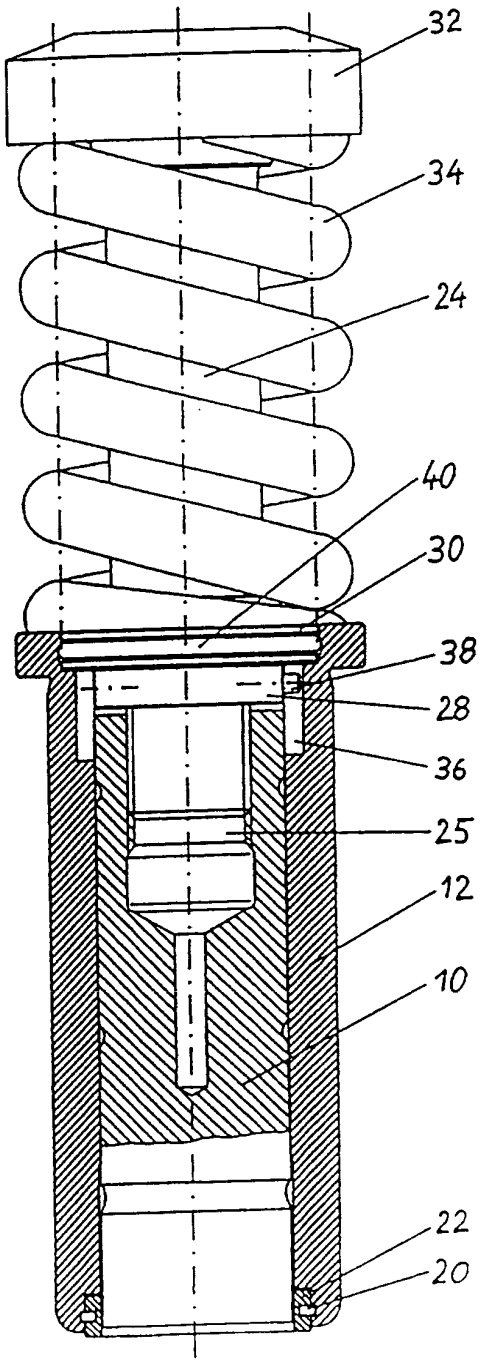


Fig. 3

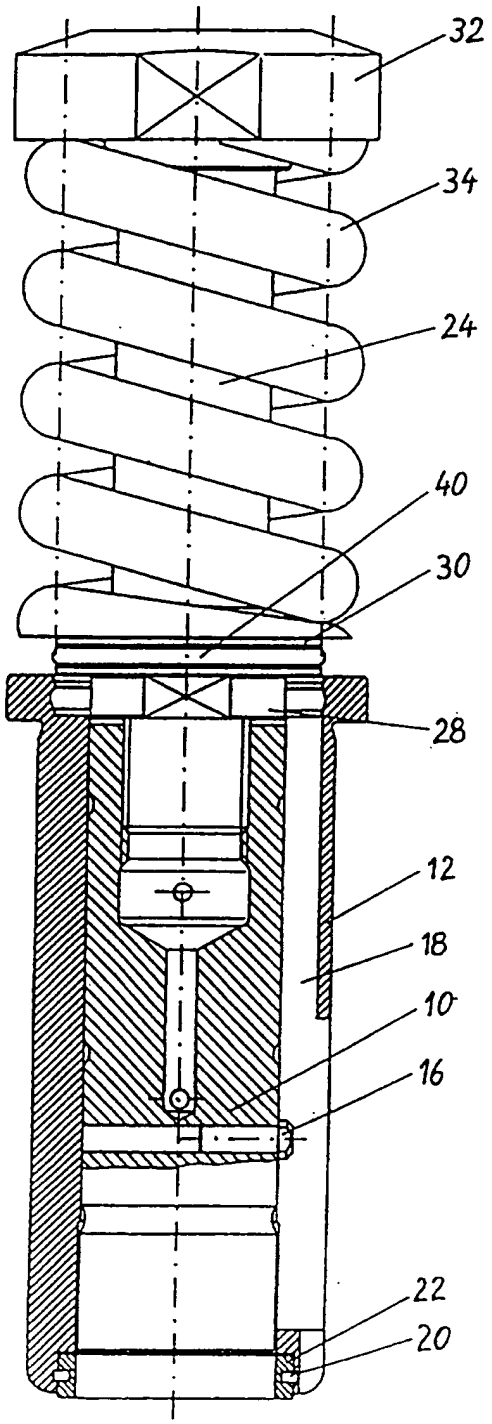
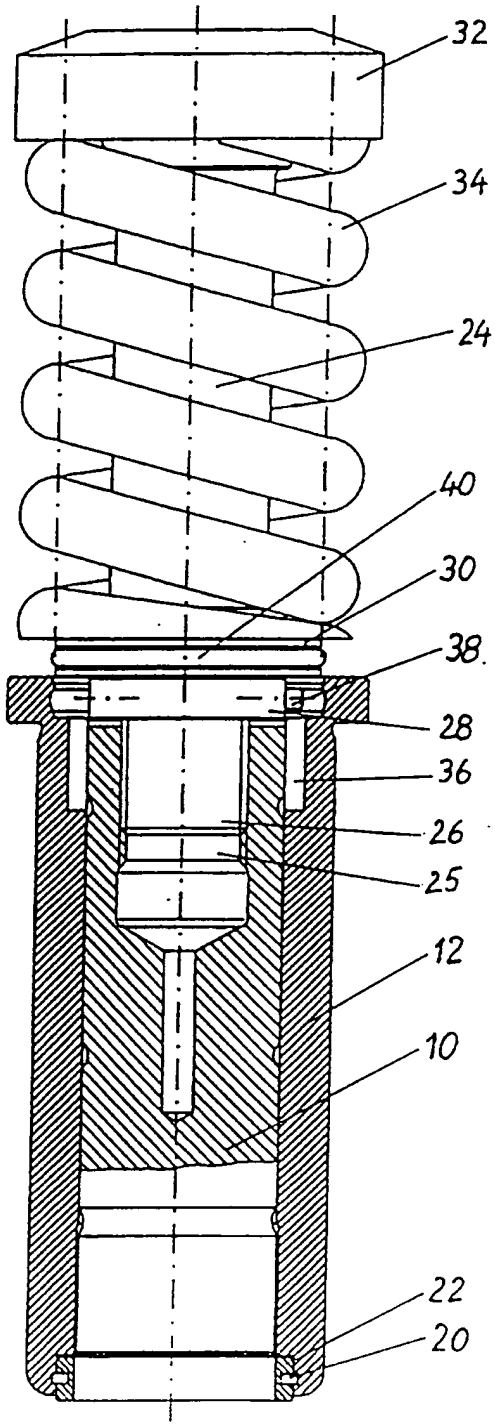


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/09329

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :Please See Extra Sheet.
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 83/140, 684, 686, 697, 698.31, 698.91, 699.41, 699.61, 143, 138

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US, A, 5,131,303 (WILSON ET AL.) 21 JULY 1992, See columns 2-5; figures 3, 4 and 5.	1 ---- 2-9
Y	US, A, 4,440,052 (WEISBECK) 03 APRIL 1984, See columns 4-6; figures 2-7.	1-9
Y	US, A, 3,935,772 (DEMUS ET AL.) 03 FEBRUARY 1976, See columns 2-3; figures 1-4.	1-9
Y	US, A, 5,056,392 (JOHNSON ET AL.) 15 OCTOBER 1991, See columns 3-7; figures 2, 5-7.	1-9

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/09329

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, A, 6,153,82 (OTSUKA) 25 JANUARY 1994, See abstract; figures 1-5.	1-9
A, P	JP, A, 6,226,373 (FUJITA) 16 AUGUST 1994, See abstract; figure 1.	1-9
A, P	US, A, 5,419,225 (FUJITA) 30 MAY 1995, See columns 2-3, figure 1.	1-9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/09329

A. CLASSIFICATION OF SUBJECT MATTER:
IPC (6):

B26F 1/14